Biometrics for Human-machine Team Feedback in Autonomous Systems

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Description:
This topic is supported under National Robotics Initiatives (NRI). OBJECTIVE: Develop and use biometrics that provides feedback about the status of human-machine team in autonomous systems. DESCRIPTION: Intense workload and short deadlines place a great deal of stress on warfighters applying computer systems to complete their mission. Biometric techniques show promise for detecting variations in human workload, stress, fatigue, and engagement when these systems are in the testing and evaluation stages of development (Bonner & Wilson, 2002; Murai, Okazaki, & Hayashi, 2004; Hockey, Gaillard, & Burov, 2004). Health monitoring systems could use biometric data collected for to make informed decisions about the human operator's condition (Carter, Cheuvront, Sawka, 2004). Having detected these factors, the software could provide a human impairment profile to better address the human's interaction with the proposed autonomous system. The new sensors must minimize interference with the warfighter's ability to complete the testing sessions or mission. For example the sensors cannot require excessive apparatus or a lengthy calibration training period. Both psychophysiology and affective computing have explored many avenues of research, including speech, facial expressions, gestures, central nervous system responses and autonomic nervous system responses (Zeng et al., 2009; Calvo and D"Mello, 2010). Among these, autonomic nervous system (ANS) responses such as cardiorespiratory and electrodermal responses hold a great deal of promise in physiological computing since they can be measured more cheaply, quickly and unobtrusively than central nervous system responses. PHASE I: Identify or design sensors that can unobtrusively monitor human operators for human state

assessment with a quantifiable impact on task performance. Design a sensor system and provide proof-of-concept supporting data on the ability of said design to accurately assess the cognitive state of engineers during test activities. PHASE II: Prototype the designed sensor system. Demonstrate that sensor information improves human operator cognitive state assessment and can lead to improved performance and productivity during test engineering activities. Develop prototype mobile application to facilitate the cognitive state assessment in operational environments. PHASE III: Fully developed cognitive state assessment systems that have numerous applications relevant to the Department of Defense, especially where fatigue or information overload are responsible for elevated error rates. Industry applications include operation and safety in areas such as transportation, energy and medicine.